CONTENTS

	Page
Natural Reproduction from Seed Stored in the Forest Floor. J. V. HOFMANN	1
A New Parasitic Nema, Tylenchus penetrans, Found Infesting Cotton and Potatoes. N. A. COBB	27
Endrot of Cranberries. C. L. SHEAR	35
Some Factors Affecting Nitrate-Nitrogen Accumulation in Soil. P. L. GAINEY and L. F. METZLER	43
Conglutination Test for the Diagnosis of Glanders. H. W. SCHOENING	65
Occurrence of Manganese in Insect Flowers and Insect Flower Stems. C. C. MCDONNELL and R. C. ROARK	77
Life History of Macrosiphum illinoisensis, the Grapevine Aphis. A. C. BAKER	83
Effect of Sulphur on Different Crops and Soils. O. M. SHEDD	91
A Statistical Study of Some Indirect Effects of Certain Selections in Breeding Indian Corn. H. L. RIETZ and L. H. SMITH	105
Some Notes on the Direct Determination of the Hygroscopic Coefficient. FREDERICK J. ALWAY, MILLARD A. KLINE, and GUY R. MCDOLE	147
Inheritance Studies in Pisum: IV.—Interrelation of the Genetic Factors of Pisum. ORLAND E. WHITE	167
Fungus Fairy Rings in Eastern Colorado and Their Effect on Vegetation. H. L. SHANTZ and R. L. PIEMEISEL	191
Run-off from the Drained Prairie Lands of Southern Louisiana. CHARLES W. OKEY	247
Diagnosing White-Pine Blister-Rust from Its Mycelium. REGINALD H. COLLEY	281
Effect of Temperature Aeration and Humidity on Jonathan-Spot and Scald of Apples in Storage. CHARLES BROOKS and J. S. COOLEY	287
Studies in Greenhouse Fumigation with Hydrocyanic Acid: Physiological Effects on the Plant. WILLIAM MOORE and J. J. WILLAMAN	319
Effect of Pumping from a Shallow Well on the Ground-Water Table. WALTER W. WEIR	339
Reactions of the Phosphorus of the Thickened Root of the Flat Turnip. BURT L. HARTWELL, F. S. HAMMETT, and P. H. WESSELS	359
Three-Lined Fig-Tree Borer. J. R. HORTON	371
A Statistical Study of Body Weights, Gains, and Measurements of Steers During the Fattening Period. B. O. SEVERSON and PAUL GERLAUGH	383
Life History of Ascaris lumbricoides and Related Forms. B. H. RANSOM and W. D. FOSTER	395

Page

Experiments in Field Technic in Rod Row Tests. H. K. HAYES and A. C. ARNY 399
Hydrocyanic-Acid Gas as a Soil Fumigant. E. RALPH DE ONG. 421
Enzyms of Milk and Butter. R. W. THATCHER and A. C. DAHLBERG 437
Influence of the Degree of Fatness of Cattle Upon Their Utilization of Feed. HENRY PRENTISS ARMSBY and J. AUGUST FRIES 451
Podblight of the Lima Bean Caused by Diaporthe phaseolorum. L. L. HARTER 473
Tests of a Large-Sized Reinforced-Concrete Slab Subjected to Eccentric Concentrated Loads. A. T. GOLDBECK and H. S. FAIRBANK 505
Temperatures of the Cranberry Regions of the United States in Relation to the Growth of Certain Fungi. NEIL E. STEVENS.. 521
Movement of Soluble Salts Through Soils. M. M. MCCOOL and L. C. WHEETING 531
Breeding Sweet Corn Resistant to the Corn Earworm. G. N. COLLINS and J. H. KEMPTON 549
Flaxwilt: A Study of the Nature and Inheritance of Wilt Resistance. W. H. TISDALE 573
Nature and Rate of Growth in Lambs During the First Year. E. G. RITZMAN 607
Bacterial-Blight of Barley. L. R. JONES, A. G. JOHNSON, and C. S. REDDY 625
Influence of the Age of the Cow on the Composition and Properties of Milk and Milk Fat. C. H. ECKLES and L. S. PALMER..... 645
Soil Acidity and the Hydrolytic Ratio in Soils. C. H. SPURWAY. 659
Structure of the Pod and the Seed of the Georgia Velvet Bean, Stizolobium deeringianum. CHARLES V. PIPER and J. MARION SHULL 673
Decomposition of Green and Stable Manures in Soil. R. S. POTTER and R. S. SNYDER 677
Eupatorium urticaefolium as a Poisonous Plant. C. DWIGHT MARSH and A. B. CLAWSON 699
Index 717

ERRATA

Page 1, line 11, "(*Juniperus occidentalis* Hook)" should read "(*Thuya plicata* D. Don)."
Page 78, line 18 from bottom, "Jadin and Astruc (4)" should read "Jadin and Astruc (5)."
Page 79, Table I, "Phosphoric" should read "Phosphoric acid."
Page 144, Table V, column 5, "Coefficient of variation" should read "Coefficient of variability."
Page 147, "Kline" should read "Klein."
Page 193, lines 8, 21, "*Agaricus oceades*" should read "*Agaricus oreades*."
Page 195, Table I, column 2, "*Agaricus caryophylleus*" should read "*Marasmius caryophylleus*."
Page 301, last line, legend of figure 17, "September 29" should read "September 9."
Page 461, line 10 from bottom, "Meek" should read "Meeh."
Page 523, legend of figure 2, "during 1916" should be omitted.
Page 556, Table IV, heading, "years" should read "ears."
Page 580, lines 10 and 11, "detaining" should read "destaining."
Page 588, line 30, "(Pl. 44, C)" should read "(Pl. 44, C, a)."
Page 699, line 17, "E. R. Brooks" should read "E. W. Brooks."

ILLUSTRATIONS

PLATES

Natural Reproduction From Seed Stored in the Forest Floor

Page

Plate 1. A general view of a representative portion of the Yacolt Burn of 1902, Columbia National Forest, looking southward from Lookout Mountain. 26

Plate 2. A.—"Interrupted" reproduction of noble fir on the west slope of Lookout Mountain. B.—The picture shows the method of measuring the height of the seedlings by means of a graduated stick which was used also in determining the width of the transect, 8¼ feet. A representative stand of noble- and silver-fir reproduction on the northeast slope of Lookout Mountain. C.—A fire line cut through 18 inches of litter and duff, Foss River fire, September, 1914, Snoqualmie National Forest. D.—This picture was taken just inside the fire line, about 15 feet from the upper picture. 26

Plate 3. A 20-year-old stand of Douglas fir (with white pine and others) which succeeded a single fire. 26

Plate 4. A.—Reproduction in a 1902 burn of the Cowlitz area, about 10 chains from the nearest seed trees. B.—Results of a 1910 fire following a 1902 burn. 26

Plate 5. A.—Douglas fir, 16 years old, which has been producing seed since its fourteenth year. B.—A clump of reproduction which escaped a 1910 fire (Upper Cispus, Rainier National Forest). C.—A clump of true firs which escaped all fires, surrounded by a small area of reproduction which resulted from 1875 fire, but was injured, and some of it destroyed by subsequent fires, notably that of 1892. D.—A barren waste left where the fire of 1892 followed the fire of 1875. 26

Plate 6. A.—Reproduction resulting from a single fire in a typical mature fir forest. B.—Homesteaders clearing in an alder "bottom" surrounded by second growth Douglas fir. 26

Plate 7. A.—Douglas-fir reproduction in the brush thickets of the Cispus burn, Rainier National Forest. B.—A 1902 fire followed by a 1910 fire, photographed in 1915, Oregon National Forest, near Summit R. S. C.—Reproduction 20 years old, at Esperance, Wash. 26

Endrot of Cranberries

Plate A. 1.—Five Late Howe cranberries showing typical appearance of endrot starting at the blossom end. 2, 3.—Cranberries from Wisconsin, showing the appearance of the endrot starting at the stem end. 4.—Entirely rotten berry affected with endrot. 5.—Appearance of endrot on the lighter-colored fruit, beginning at the stem end. 6, 7.—Cultures of the endrot 46 days old on stems of *Melilotus alba*, showing the various color changes in the fungus from the youngest to the oldest growth. 8.—Culture of the endrot fungus 39 days old on cranberry agar-gelatin, showing the various colors produced. 42

LIFE HISTORY OF MACROSIPHUM ILLINOISENSIS, THE GRAPEVINE APHIS

Page

PLATE 8. *Macrosiphum illinoisensis:* A.—Antenna of male. B.—Antenna of fall migrant. C.—Colony on grape leaf. D.—Colony on grape leaf..... 90

PLATE 9. *Macrosiphum illinoisensis:* A.—Summer winged viviparous female, and details. B.—Summer wingless viviparous female, first instar. C.—Summer wingless viviparous female, fifth instar or adult. D.—Pupa of summer winged viviparous female..... 90

FUNGUS FAIRY RINGS IN EASTERN COLORADO AND THEIR EFFECT ON VEGETATION

PLATE 10. *Agaricus tabularis:* A.—Three fruiting bodies about 10 to 15 cm. in diameter showing variation in the pileus. B.—Large, firm, fleshy fruiting bodies 10 to 15 cm. in diameter. C.—Three typical fruiting bodies. D.—Bottom view of fruits 7 to 15 cm. in diameter..... 246

PLATE 11. *Agaricus tabularis:* A.—Sporophores developed in a dense stand of *Agropyron smithii*, which protected them from rapid drying. B.—Sporophore from the same ring as figure A, but freely exposed and showing the rough scaly top. C.—Typical of fruiting bodies exposed on dry hot days..... 246

PLATE 12. *Agaricus tabularis*: A, B.—Two fruiting bodies showing smooth and nearly smooth pileus. C, D.—Two fruiting bodies showing the rough or tabular structure of the pileus..... 246

PLATE 13. *Agaricus tabularis:* A.—Two fruiting rings showing large fruiting bodies about 15 cm. in diameter and of relatively uniform size. B.—A ring just after the fruiting period..... 246

PLATE 14. *Agaricus tabularis:* A.—A fruiting ring. B.—The mycelium as it appears on the soil mass. C.—A trench across a ring of *A. tabularis* in a Kubanka wheat plot, showing the mycelium in the soil..... 246

PLATE 15. *Agaricus tabularis:* A.—A trench across a fairy ring. B.—Another trench showing a different distribution of the mycelium in the soil..... 246

PLATE 16. *Agaricus tabularis:* A.—General appearance of a fairy ring formed by *A. tabularis* during a dry year. B.—General view of a ring formed by *A. tabularis;* photographed during a dry year..... 246

PLATE 17. *Agaricus tabularis:* A.—A trench through the ring shown in Plate 16, A. B.—A trench through the ring shown in Plate 16, B..... 246

PLATE 18. *Agaricus tabularis:* A ring which produced only a few mushrooms in 1915..... 246

PLATE 19. *Agaricus tabularis:* A.—Part of a large ring, showing 42 mushrooms. B.—A large ring, showing 75 fresh mushrooms..... 246

PLATE 20. *Agaricus tabularis:* A ring caused by *A. tabularis* and distinguished by a uniform growth of *Plantago purshii*..... 246

PLATE 21. *Agaricus tabularis*: A.—Effect of a ring on Kubanka wheat. B.—The stubble showing the distribution of the ring of *A. tabularis*..... 246

PLATE 22. *Agaricus tabularis:* A.—A ring formed by *A. tabularis* in a field of Turkey wheat. B.—A trench across the ring shown in the figure above... 246

PLATE 23. A.—Method of measuring the penetration of water in three zones of a ring of *Agaricus tabularis*. B.—A ring of *Agaricus arvensis* showing the effect of irrigation during a dry year on the different zones..... 246

PLATE 24. A.—A trench across the irrigated plot shown in Plate 19, B. B.—A ring of *Calvatia cyathiformis* photographed August 21, 1907, 16 miles north of Cheyenne Wells, Colo..... 246

Page

PLATE 25. *Calvatia cyathiformis:* A.—A ring showing stimulation of native plants inside the fruiting zone. B.—A trench through fruiting zone of *C. cyathiformis*..... 246

PLATE 26. A.—A ring of *Calvatia cyathiformis* producing a second crop of puffballs. B.—A large ring formed by *Lepiota morganii*, showing a second crop of fruiting bodies..... 246

PLATE 27. A.—Three stages in the ripening of sporophores of *Calvatia cyathiformis*. B.—Effect of a ring of *C. cyathiformis* on the density of the short-grass sod. C.—Three fruiting bodies of *Lepiota morganii* in place in the fairy rings shown in Plate 22B..... 246

PLATE 28. A.—A small ring formed by *Agaricus campestris*, showing a total of 29 mushrooms. B.—A large ring of *Calvatia polygonia*, showing 14 fruiting bodies..... 246

PLATE 29. *Calvatia polygonia:* A.—Two fresh fruiting bodies, showing the character of the peridium at different stages. B.—An old fruiting body dried in place, showing the thick peridium scales. C.—A large fruiting body 30 cm. across, which for some reason has split open during the early growth period..... 246

PLATE 30. A.—The effect of a ring of *Agaricus tabularis* on the native vegetation. B.—A ring of *Catastoma subterraneum*. C.—A very small ring apparently caused by a fungus but marked only by a more luxuriant growth of *Festuca octoflora*..... 246

DIAGNOSING WHITE-PINE BLISTER-RUST FROM ITS MYCELIUM

PLATE 31 *Cronartium ribicola:* A.—A tangential section, showing strands of hyphæ among the white-pine host cells. B.—A haustorium showing the characteristic bend and irregular outline..... 286

EFFECT OF TEMPERATURE AERATION AND HUMIDITY ON JONATHAN-SPOT AND SCALD OF APPLES IN STORAGE

PLATE 32. Apple-scald: Grimes apples, showing the effect of storing at 15° C... 318

PLATE 33. Apple-scald: A.—Grimes apples, showing the effect of storing at 10° C. B.—Grimes apples, showing the effect of storing them at 10° C. C.—An apple with part of its surface inclosed in a tumbler..... 318

STUDIES IN GREENHOUSE FUMIGATION WITH HYDROCYANIC ACID: PHYSIOLOGICAL EFFECTS ON THE PLANT

PLATE 34. A.—Tomato plants in the greenhouse at beginning of growth experiment. B.—Tomato plants when in fruit, showing the method of handling..... 338

THREE-LINED FIG-TREE BORER

PLATE 35. *Ptychodes trilineatus:* Immature stages. A.—Egg. B, C.—Full-grown larva. D, E.—Pupa..... 382

PLATE 36. *Ptychodes trilineatus:* Adult. A.—Female. B.—Male..... 382

PLATE 37. *Ptychodes trilineatus:* A.—Feeding injury of the larva. B.—Dead fig tree, showing injury by the three-lined fig-tree borer and other boring insects..... 382

A Statistical Study of Body Weights, Gains, and Measurements of Steers During the Fattening Period

Page

Plate 38. A.—A "fair feeder" showing infusion of some Shorthorn blood. B.—A "good feeder" of Shorthorn breeding. C.—A "choice feeder" of Shorthorn breeding 394

Plate 39. A.—Measuring the depth of the chest of a steer with calipers. B.—Measuring the circumference of the chest of a steer 394

Hydrocyanic-Acid Gas as a Soil Fumigant

Plate 40. Soil tube connected to air pump and jar containing hydrocyanic-acid-gas solution 436

Influence of the Degree of Fatness of Cattle Upon Their Utilization of Feed

Plate 41. A.—The steer before fattening. B.—The steer after fattening 472

Podblight of the Lima Bean Caused by Diaporthe phaseolorum

Plate 42. *Diaporthe phaseolorum:* A.—A leaflet of *Phaseolus lunatus* L., showing a number of ragged holes of various sizes caused by the Lima bean podblight fungus. B.—A green Lima bean pod photographed 10 days after inoculation with the ascospore strain. C.—A pod showing the characteristic manner in which the fungus rapidly overruns it soon after it is killed, pycnidia forming indiscriminately over the entire surface 504

Plate 43. *Diaporthe phaseolorum:* A.—A vertical section through a pycnidium from the leaf. B.—A vertical section through a pycnidium from a pod showing the beak and the thickened dark wall surrounding it. C.—A vertical section through the epidermis and underlying host of a portion of a diseased pod showing the connection and chambering of the pycnidia. D.—A somewhat diagrammatic drawing of a portion of the surface of a Lima bean pod, showing the distribution of the perithecia, the shape of the beaks, and their projection from the surface. E.—A surface view of a portion of a bean pod showing arrangement of the pycnidia and fusion of the beaks. F.—A vertical section through a perithecium from a pod 504

Flaxwilt: A Study of the Nature and Inheritance of Wilt Resistance

Plate 44. A.—Flax seedlings as grown in the tube culture for penetration studies. B.—Flax plants growing in North Dakota "flax-sick soil." C.—Flax plants grown on soil from Madison, Wis. 606

Plate 45. A.–D.—Flax plants growing on North Dakota "flax-sick soil" 606

Plate 46. A.—Flax plants growing in soil inoculated artificially with *Fusarium lini*. B.—Second-generation flax plants growing on artificially infected soil. C.—Second-generation flax plants growing in North Dakota "flax-sick soil" 606

Bacterial-Blight of Barley

Plate B. 1.—Healthy barley leaf for comparison. 2.—Early stage of bacterial-blight showing a translucent, water-soaked stripe along the midrib, yellowing toward the apex. 3.—More advanced stage of bacterial-blight of barley where numerous local invasions have developed. 4.—Barley seedling showing abundant infection spots on the lower leaf from atomizer inoculation with strain isolated from old infected seed. 5.—Barley seedling similarly infected with strain isolated from blighting leaf 644

Page

PLATE 47. A.—Barley leafblight, showing exudate gathered in three grayish glistening drops on the surface of the water-soaked blighting area. B.—Blighting barley leaf. Early stage of mid-leaf stripe invasion, this stripe showing the water-soaked translucent appearance, the grayish exudate so abundant as to have formed a glistening droplet just above the ligule. C.—Blighting barley leaves, natural infection. *a*, A small insect (midge) entrapped in the exudate. *b*, The dry, thin grayish exudite film (X) at the lower part of the blighted area is partly detached and turned back. The exudate film is so nearly transparent that the leaf veins are slightly visible through it. D.—Barley leaf, showing general blighting, the surface studded with numerous exudate droplets hardened into yellowish resinous granules, readily dislodged 644

PLATE 48. A.—Photomicrograph of a bead of hardened exudate dissolving in water under microscope. B.—Five-day-old agar slant cultures of *Bact. translucens* incubated at 24° C. C.—Colonies of *Bact. translucens* on peptone-beef agar plate, dilution culture from bouillon 644

PLATE 49. A.—Blighting barley culms at heading stage. B.—Barley seedlings showing abundant infections on first leaves three days after atomizer inoculation with strain of organism isolated from 2-year-old seed 644

STRUCTURE OF THE POD AND THE SEED OF THE GEORGIA VELVET BEAN, STIZOLOBIUM DEERINGIANUM

PLATE 50. A.—Thin-walled parenchyma forming the satin tissue that lines the pod. B.—Cross section of a vascular bundle of the pod. C.—Section of epidermis of pod, showing a stoma and several of the basal cells from which the hairs arise. D.—Fiber cells. E.—Fiber cell in longitudinal section. F.—Fiber cells in cross section. G.—Cross section of velvet-bean pod, showing both conditions of surface hairs arising from the epidermal layer. H.—Sclerenchyma cells. I.—Sclerenchyma cells. J.—Sclerenchyma cells in cross section 676

PLATE 51. A.—Georgia velvet bean. B.—Cross section through hilum, showing thick-walled parenchyma of the caruncle and the very short palisade cells of the hilar tissues. C.—Palisade cells of seed coat, top view. D.—Palisade cells of seed coat. E.—Cross section through seed coat elsewhere than at the hilum, showing relationship of palisade cells, hour-glass cells, and the underlying parenchyma. F.—Hour-glass cells seen from above. G.—Hour-glass cells, side view. H.—Spirals from vascular bundles of the seed coat. I.—Cross section of cotyledon, showing outer epidermis, and smaller cells filled with starch grains and proteid granules. J.—Cross section of cotyledons, showing the medial line of the two cotyledons with inner epidermis and adjoining much larger cells with starch grains and proteid granules correspondingly larger 676

EUPATORIUM URTICAEFOLIUM AS A POISONOUS PLANT

PLATE 52. *Eupatorium urticaefolium*, white snakeroot 716

PLATE 53. Poisoning by *Eupatorium urticaefolium:* A.—Sheep 309, showing weakness. B.—Sheep 309, showing trembling 716

PLATE 54. Poisoning by *Eupatorium urticaefolium:* A.—Sheep 367 at 11.17 a. m. on September 30. B.—Sheep 367 at 11.20 a. m. on September 30.. 716

PLATE 55. Poisoning by *Eupatorium urticaefolium:* A.—Sheep 368 on September 24. B.—Sheep 368 a little later the same day 716

23720°—18——2

TEXT FIGURES

Natural Reproduction from Seed Stored in the Forest Floor

Page

Fig. 1. Migration chart: Graphic representation of the number of seedlings per acre in each chain distance from seed trees. Kaniksu National Forest 1
2. Plan of survey on Columbia burn 4
3. Curve showing the germination of white-pine seed in the Columbia burn 11 years after the fire 9
4. Ground plan of the spot shown in Plate 2, A 11

A New Parasitic Nema Found Infesting Cotton and Potatoes

Fig. 1. *Tylenchus penetrans:* Adult female 28
2. Potato pustules caused by the nema *Tylenchus penetrans* 29
3. *Tylenchus penetrans:* Profile of the tail end and bursa of the male 32
4. *Tylenchus penetrans:* Ventral view of the tail end of the male 32
5. Diagram showing measurements of a nema and the corresponding formula 33

Endrot of Cranberries

Fig. 1. *Fusicoccum putrefaciens: a*, Vertical section of a simple pycnidium grown in pure culture on sterile sweet clever stems (*Melilotus alba*); *b*, vertical section of a chambered pycnidium from a corn-meal-agar culture; *c*, part of a section of *a* showing sporophores and spores; *d*, separate sporophores and spores from pure culture 37
2. *Fusicoccum putrefaciens: a*, Median vertical section of a pycnidium growing in the angle beneath the old calyx lobe of an old rotten cranberry; *b*, similar section of a two-chambered pycnidium, with part of the apical portion gone; *c*, portion of inner wall of a pycnidium, showing simple and branched sporophores with immature spores; *d*, separate pseudoseptate spores 37
3. *Fusicoccum putrefaciens: a*, Vertical section of a young pycnidium embedded in the tissue of a recently rotted cranberry; *b*, vertical section of a nearly mature pycnidium showing two chambers; *c*, separate branched and simple sporophores with immature spores; *d*, separate spores, showing variations in form and size 38

A Statistical Study of Some Indirect Effects of Certain Selections in Breeding Indian Corn

Fig. 1. Graphs showing the mean length of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915 114
2. Graphs showing the mean circumference of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915 116
3. Graphs showing the mean weight of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915 117
4. Graphs showing the mean number of rows of kernels in the four Illinois strains of Indian corn for 11 crops, 1905-1915 117
5. Graphs showing the standard deviation of the length of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915 119
6. Graphs showing the standard deviation of the circumference of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915. 119
7. Graphs showing the standard deviation of the weight of the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915 120

Page

FIG. 8. Graphs showing the standard deviation of the rows of kernels on the ears in the four Illinois strains of Indian corn for 11 crops, 1905-1915. 121
9. Graphs showing the mean length of the ears in the two-ear strains of Indian corn, 1908-1916. 123
10. Graphs showing the mean circumference of the ears in the two-ear strains of Indian corn, 1908-1916. 123
11. Graphs showing the mean weight of the ears in the two-ear strains of Indian corn, 1908-1916. 124
12. Graphs showing the mean number of rows of kernels in the two-ear strains of Indian corn, 1908-1916. 124
13. Graphs showing the standard deviation of the length of the ears in the two-ear strains of Indian corn, 1908-1916. 132
14. Graphs showing the standard deviation of the circumference of the ears in the two-ear strains of Indian corn, 1908-1916. 132
15. Graphs showing the standard deviation of the weight of the ears in the two-ear strains of Indian corn, 1908-1916. 133
16. Graphs showing the standard deviation of the number of rows of kernels in the two-ear strains of Indian corn. 133
17. Graphs showing the mean length of the ears of the erect- and declining-ear strains of Indian corn. 134
18. Graphs showing the mean circumference of the ears of the erect- and declining-ear strains of Indian corn. 134
19. Graphs showing the mean weight of the ears of the erect- and declining-ear strains of Indian corn. 135
20. Graphs showing the mean number of rows of kernels on the ears of the erect- and declining-ear strains of Indian corn. 135
21. Graphs showing the standard deviation of the length of the ears of the high- and low-ear strains of Indian corn. 140
22. Graphs showing the standard deviation of the circumference of the ears of high- and low-ear strains of Indian corn. 140
23. Graphs showing the standard deviation of the height of the ears of high- and low-ear strains of Indian corn. 141
24. Graphs showing the standard deviation of the number of rows of kernels on the ears of high- and low-ear strains of Indian corn. 141

FUNGUS FAIRY RINGS IN EASTERN COLORADO AND THEIR EFFECT ON VEGETATION

FIG. 1. A sketch of a fairy ring produced by *Marasmius oreades*. 197
2. A map of an area of 400 by 620 meters, lying just west of the experiment station and north of the Chicago, Burlington & Quincy R. R., near Akron, Colo. 199
3. A sketch showing the different zones in a typical ring formed by *Agaricus tabularis*. 200
4. A bisect of the *Agaricus tabularis* ring shown in figure 3 at A. 201
5. Sketch of a ring produced by *Calvatia cyathiformis*. 202
6. A bisect of a ring sketched in figure 5. 203
7. A sketch of a fairy ring formed by *Lepiota morgani* southeast of Yuma, Colo. 204
8. Remapped area shown in figure 2. 205
9. A ring formed by *Calvatia cyathiformis*, almost complete and 65 meters in diameter. 207
10. This *Agaricus tabularis* ring was partly within a cornfield and partly within the native short-grass sod. 214

Page

FIG. 11. A sketch of ring 1 made in August, 1915. 216
12. A detail map of ring 5 shown in the lower left-hand corner of the map. . 217
13. A bisect and transect of an *Agaricus tabularis* ring at Akron, Colo. . . . 218
14. A bisect of a ring of *Agaricus tabularis* in a wheat field in 1915. 230
15. A sketch of the stages in the succession leading to the reestablishment of the short grass following its destruction by *Agaricus tabularis*. . . . 239

RUN-OFF FROM THE DRAINED PRAIRIE LANDS OF SOUTHERN LOUISIANA

FIG. 1. Probable actual run-off for storm periods of from one to four days, Smithport Planting Company tract and Willswood Plantation. 273
2. Probable actual run-off for storm periods of from one to five days, Lafourche Drainage District No. 12 and New Orleans Land Company tract. 274
3. Probable actual run-off for storm periods of from one to four days, Gueydan Drainage District and Des Allemands Polder No. 1. 275
4. Probable actual run-off for storm periods of from one to three days, Jefferson Drainage District No. 3 and Lafourche Drainage District No. 12. 276
5. Composite curves for eight districts, showing probable run-off for storm periods of from one to four days. 277

DIAGNOSING WHITE-PINE BLISTER-RUST FROM ITS MYCELIUM

FIG. 1. *Cronartium ribicola: a*, A moderately straight haustorium which has dented the side of the host nucleus. *b*, A branched haustorium in a young medullary-ray cell. 285

EFFECT OF TEMPERATURE AERATION AND HUMIDITY ON JONATHAN-SPOT AND SCALD OF APPLES IN STORAGE

FIG. 1. Graphs showing the effect of temperature on Jonathan-spot at the end of 2, 6, and 8 weeks. 289
2. Graphs showing the effect of temperature on Jonathan-spot at the end of 4, 5, 6, 7, 8, 10, 12, and 14 weeks. 290
3. Graphs showing the effect of temperature on Jonathan-spot at the end of 4, 6, 8, 10, and 12 weeks. 290
4. Graphs showing the effect of temperature on Jonathan-spot at the end of 4, 5, 6, 7, 8, 10, 12, and 14 weeks. 291
5. Graphs showing the effect of temperature on Jonathan-spot at the end of 4, 5, 6, 7, 8, 10, 12, and 14 weeks. 291
6. Graphs showing the effect of aeration and humidity on Jonathan-spot. . 292
7. Graphs showing the effect of the maturity of fruit on Jonathan-spot. . . . 292
8. Graphs showing the effect of maturity of fruit and of aeration and humidity on Jonathan-spot. 293
9. Graphs showing the effect of temperature on apple-scald at the end of 9, 12, and 15 weeks. 295
10. Graphs showing the effect of temperature on apple-scald at the end of 6, 7, 9, 10, 13, and 15 weeks. 296
11. Graphs showing the effect of temperature on apple-scald at the end of 3, 4, 5, 6, 7, 8, 9, 10, 14, and 19 weeks. 296
12. Graphs showing the effects of temperature on apple-scald at the end of 6, 7, 8, 9, 11, 14, 15, 18, 21, and 23 weeks. 297
13. Graphs showing the effect of temperature on apple-scald at the end of 4, 5, 6, 7, 8, 9, 12, 15, 16, 19, and 21 weeks. 297

Page

FIG. 14. Graphs showing the effect of temperature on apple-scald at the end of 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, and 17 weeks 298
15. Graphs showing the effect of temperature on apple-scald at the different temperatures at the end of 4, 5, 6, 7, 9, 10, 13, and 15 weeks 298
16. Graphs showing the effect of aeration and humidity on apple-scald ... 299
17. Graphs showing the amount of scald on Grimes apples from 0° and 5° C., 3 days after removal from storage 301
18. Graphs showing the development of color on Grimes apples in storage .. 302
19. Graphs showing the development of color on Grimes apples in storage .. 302
20. Graphs showing the development of color on Grimes apples in storage .. 303
21. Graphs showing the influence of aeration and humidity upon the color development of Grimes apples in storage at 15° C. 303
22. Graphs showing the influence of aeration and humidity upon the color development of Grimes apples in storage at 15° C. 310
23. Graphs showing the influence of aeration and humidity upon the color development of Grimes apples in storage at 15° C. 311

STUDIES IN GREENHOUSE FUMIGATION WITH HYDROCYANIC ACID: PHYSIOLOGICAL EFFECTS ON THE PLANT

FIG. 1. Curves showing in two samples of tomato leaves the effect on oxidase activity of the presence of hydrocyanic acid during the determination 322
2. Curves showing the oxidase activity of leaf powders treated with varying concentrations of hydrocyanic-acid solution, the latter having been removed before the determination was made 322
3. Curves showing the hourly activity of the oxidases of fumigated and of normal tomato plants 323
4. Curves showing the oxidase activity of fumigated and of unfumigated tomato plants over a period of eight weeks 323
5. Curves showing the effect of hydrocyanic-acid fumigation on the activity of the catalase in tomato 324
6. Curves showing the rate of respiration (in milligrams of carbon dioxid per hour per 1 gm. of dry matter in plant) of four pairs of tomato plants 325
7. Growth curves of three sets of tomato plants as affected by hydrocyanic-acid fumigation 329
8. Curves showing the production of fruit by the three sets of tomato plants in figure 7 330
9. Growth curves of three sets of lettuce plants, showing the effect of light and severe fumigation with hydrocyanic acid 331
10. Transpiration curves of tomatoes as affected by hydrocyanic-acid fumigation 334
11. Curves showing the cuticular transpiration of fumigated and of normal tomato plants 335

EFFECT OF PUMPING FROM A SHALLOW WELL ON THE GROUND-WATER TABLE

FIG. 1. Plan showing location of irrigation canals and test wells with reference to the pumping plant 340
2. Ground-water curves for 1914 and 1915 (wells 1, 2, and 3) 341
3. Ground-water curves for 1914 and 1915 (wells 4, 5, and 6) 343
4. Ground-water curves for 1914 and 1915 (wells 7, 8, and 9) 344
5. Ground-water curves for 1914 and 1915 (wells 10, 11, and 12) 345

Page

FIG. 6. Ground-water curves for 1914 and 1915 (wells 13, 14, and 15)..... 346
7. Ground-water curves for 1914 and 1915 (wells 16, 17, and 18)..... 347
8. Ground-water curves for 1915 (wells 19, 20, and 21)..... 348
9. Profile of water table during march, 1915..... 349
10. Profile of water table during April, 1915..... 350
11. Profile of water table during May, 1915..... 351
12. Profile of water table during June, 1915..... 352
13. Profile of water table during July, 1915..... 353
14. Profile of water table during August, 1915..... 354
15. Profile of water table for September, 1915..... 355
16. Composite curve showing water table from March to September, 1915, inclusive, at different distances from the pump..... 356

HYDROCYANIC-ACID GAS AS A SOIL FUMIGANT

FIG. 1. Diagram showing the relative heights of the alfalfa seedlings grown in hydrocyanic-acid gas solutions produced by adding sulphuric acid to sodium cyanid in solution..... 425

INFLUENCE OF THE DEGREE OF FATNESS OF CATTLE UPON THEIR UTILIZATION OF FEED

FIG. 1. Graph of the fluctuations in the live weight of the steer..... 458

PODBLIGHT OF THE LIMA BEAN CAUSED BY DIAPORTHE PHASEOLORUM

FIG. 1. *Diaporthe phaseolorum:* *A*, An early stage in the formation of a pycnidium. The epidermis (*a*) is not yet disturbed but the hyphæ (*b*) have accumulated directly beneath it. *B*, A more advanced stage of figure *A*..... 480
2. *Diaporthe phaseolorum:* Long, slender, fragile sporophores with two pycnospores attached. (*a*) Sporophores; (*b*) pycnospores..... 481
3. *Diaporthe phaseolorum:* A group of pycnospores..... 481
4. *Diaporthe phaseolorum:* Germinating pycnospores..... 482
5. *Diaporthe phaseolorum:* Stylosporophores..... 482
6. *Diaporthe phaseolorum:* A group of stylosporophores..... 482
7. *Diaporthe phaseolorum:* Mature hyphæ..... 483
8. *Diaporthe phaseolorum:* (*a*) Asci and (*b*) ascospores..... 484
9. *Diaporthe phaseolorum:* Germinating ascospores..... 485
10. *Diaporthe phaseolorum:* Some of the germ tubes of the pycnospores penetrating the stomata two days after the pods were sprayed, and other germinated spores lying alongside the stomata and growing toward or away from the aperture..... 490
11. *Diaporthe phaseolorum:* Graphic representation of growth on cooked rice at different temperatures..... 496

TESTS OF A LARGE-SIZED REINFORCED-CONCRETE SLAB SUBJECTED TO ECCENTRIC CONCENTRATED LOADS

FIG. 1. Diagram of slab A-25, showing location of deformation and deflection points..... 507
2. Central load deformation and deflection curves of slab A-25. Slab width, 32 feet..... 509
3. Eccentric load deformation and deflection curves of slab A-25. Slab width, 29 feet..... 510

Page

FIG. 4. Eccentric load deformation and deflection curves of slab A-25. Slab width, 25 feet 511
5. Eccentric load deformation and deflection curves of slab A-25. Slab width, 22 feet 512
6. Eccentric load deformation and deflection curves of slab A-25. Slab width, 18.5 feet 513
7. Eccentric load deformation and deflection curves of slab A-25. Slab width, 15.5 feet 514
8. Eccentric load deformation and deflection curves of slab A-25. Slab width, 11.5 feet 515
9. Eccentric load deformation and deflection curves of slab A-25. Slab width, 8.5 feet 516
10. Central load deformation and deflection curves of slab A-25. Slab width, 5 feet 517
11. Curve showing effective width v. width of slab 518

TEMPERATURES OF THE CRANBERRY REGIONS OF THE UNITED STATES IN RELATION TO THE GROWTH OF CERTAIN FUNGI

FIG. 1. Curves of the normal monthly rainfall during 1916 at Middleboro, Mass., Farmington, Me., Indian Mills, N. J., North Head, Wash., and Grand Rapids, Wis. 522
2. Curves of the monthly normal mean temperature at Middleboro, Mass., Farmington, Me., Indian Mills, N. J., North Head, Wash., and Grand Rapids, Wis. 523
3. Curves of the ratios of the index for *Glomerella cingulaia* to that for *Fusicoccum putrefaciens* 527

MOVEMENT OF SOLUBLE SALTS THROUGH SOILS

FIG. 1. Apparatus used in studying the movement of salts through soils 534
2. Graph of the freezing-point-lowerings after 5 days, induced by the addition of 2 per cent of potassium chlorid to silt loam with 20 per cent of moisture 536
3. Graph of the freezing-point-lowerings after 10 days, induced by the addition of 2 per cent of potassium chlorid to silt loam with 20 per cent of moisture 537
4. Graph of the freezing-point-lowerings after 5 days, induced by the addition of 0.9 per cent of potassium chlorid to sand with 9 per cent of moisture 541
5. Graph of the freezing-point-lowerings after 10 days, induced by the addition of 0.9 per cent of potassium chlorid to sand with 9 per cent of moisture 542

FLAXWILT: A STUDY OF THE NATURE AND INHERITANCE OF WILT RESISTANCE

FIG. 1. A–F, *Fusarium conglutinans* penetrating root hairs of cabbage seedlings in pure culture in test tubes. G, H, and I, *F. lini* penetrating root hairs of flax seedlings grown in test tube cultures. J, *F. lini* penetrating root hair of flax plant grown in loose, infected soil. K, *F. conglutinans* penetrating root hair of flax seedling in pure culture in test tube 577
2. *Fusarium lini* penetrating epidermis of young flax root grown in loose, infected soil 578

Page

FIG. 3. *Fusarium lini* penetrating epidermis of young flax seedling in test-tube culture 578
4. *Fusarium lini* entering stoma of young flax seedling in test-tube culture. 579
5. Longitudinal section of woody tissues of susceptible flax plant showing the invading hyphæ of *Fusarium lini* 580
6. Longitudinal section of the woody tissue of the susceptible flax plant showing the invading hyphæ of *Fusarium lini* 581
7. Cross section of the vascular tissues of a susceptible flax plant showing the invading hyphæ of *Fusarium lini* 582
8. A, Longitudinal section of the cortical parenchyma of a resistant flax root showing the formation of cork walls around the point of invasion by *Fusarium lini*. B, Longitudinal section of the cortical parenchyma of a resistant flax root showing a cork layer formed between the point of invasion and the vascular system. C, Longitudinal section of the cortical parenchyma of a resistant flax root showing cell-wall penetration by *F. lini* and the formation of cork walls between the invading hypha and the vascular system of the root. D, Cross section of the cortical parenchyma of a resistant flax root showing the heavy cork walls formed around the point of invasion by *F. lini*.. 585

NATURE AND RATE OF GROWTH IN LAMBS DURING THE FIRST YEAR

FIG. 1. Diagrams showing the proportionate growth of lambs at 14 and 280 days 613
2. Graphs of the development of lambs 615

BACTERIAL-BLIGHT OF BARLEY

FIG. 1. Outline map showing known distribution of bacterial-blight of barley in the United States 629
2. *Bacterium translucens:* From 96-hour growth on potato agar, stained by Zettnow's method to show flagella 633

INFLUENCE OF THE AGE OF THE COW ON THE COMPOSITION AND PROPERTIES OF MILK AND MILK FAT

FIG. 1. Graphs of the variation in percentage of fat of Jersey cows in successive lactation periods, and proportion of total number of cows in each group showing highest test in each period 648
2. Graphs of the variation in percentage of fat of Holstein cows in successive lactation periods, and proportion of total number of cows in each group showing highest test in each period 649
3. Graphs of the variation in percentage of fat of Ayrshire cows in successive lactation periods, and proportion of total number of cows in each group showing highest test in each period 653

DECOMPOSITION OF GREEN AND STABLE MANURES IN SOIL

FIG. 1. Graphs of the quantity of carbon evolved as carbon dioxid in the control, limed, manured, and manured and limed soils 680
2. Graphs of the quantity of carbon evolved as carbon dioxid in soils treated with oats alone and in combination with manure and lime.. 681
3. Graphs of the quantity of carbon evolved as carbon dioxid in soils treated with green clover alone and in combination with manure and lime 682

Page

FIG. 4. Graphs of the quantity of carbon evolved as carbon dioxid in soils receiving various amounts of manure used alone and in combination with lime 690

5. Graphs of the quantity of carbon evolved as carbon dioxid in soils receiving various amounts of manure used alone and in combination with lime 691

6. Graphs of the quantity of carbon evolved as carbon in soils treated with lime and oats alone and in combination with manure and lime 691

7. Graphs of the quantity of carbon evolved as carbon in soils treated with lime and oats alone and in combination with manure and lime 692

8. Graphs of the quantity of carbon evolved as carbon in soils treated with lime and clover alone and in combination with manure and lime 692

9. Graphs of the quantity of carbon evolved as carbon in soils treated with lime and clover alone and in combination with manure and lime .. 693